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Calgary family intervention model enhances dietary compliance and knowledge in T2DM patient

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ABSTRACT

The urgency was in developing a more holistic and sustainable approach to supporting type 2 diabetes mellitus (T2DM) patients. This study evaluated the effectiveness of the Calgary Family Intervention Model (CFIM) in improving dietary adherence and knowledge in patients with T2DM. This study used a quantitative method with a quasi-experimental design, involving 280 patients with type 2 diabetes mellitus at the Bolo Community Health Center from January to October 2025. The sample was divided into two groups: intervention (CFIM education) and control (booklet). Data were collected using a valid and reliable questionnaire to measure knowledge and dietary adherence. Data analysis was performed using the Wilcoxon and Mann-Whitney tests. The analysis showed significant results, with the mean knowledge score in the intervention group increasing from 4.84±1.235 to 8.98±2.851 ($p < 0.05$), while in the control group, it increased from 4.64±1.120 to 7.06±1.219. For dietary adherence, the intervention group showed an increase from 27.00±6.518 to 61.38±7.171 ($p = 0.000$), compared to the control group, which increased from 27.28±5.592 to 49.44±10.194 ($p < 0.05$). The implications of these results have the potential to strengthen the family-based health intervention model and improve the overall well-being of T2DM patients. This study contributes significantly to family nursing practice by demonstrating the efficacy of the CFIM in enhancing dietary adherence and knowledge among patients with T2DM.

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1. INTRODUCTION

The growing global prevalence of type 2 diabetes mellitus (T2DM) necessitates effective strategies to enhance dietary compliance among patients. Interventions that emphasize family involvement have shown promise in improving dietary knowledge and adherence. For instance, research indicates that family support significantly influences dietary compliance in T2DM patients, enhancing their nutritional education and self-management behaviors [1], [2]. Educational programs utilizing models such as the extended parallel process model (EPPM) have demonstrated positive outcomes in promoting dietary adherence and glycemic control [3], reinforcing the critical role of structured nutritional education.

Previous research showed that family support is a pivotal factor influencing the dietary compliance and self-management behaviors of patients with T2DM. Setyoadi *et al.* [4] highlight that active family involvement significantly bolsters dietary adherence, particularly among patients with limited knowledge about diabetes management. Moreover, Albahrani's findings underscore the positive impact of family-based

health education programs in enhancing the self-care capabilities of T2DM patients, thus improving clinical outcomes [5]. This is reflective of a broader consensus that engaging family members in health management facilitates comprehensive support for the patient [6].

The research gap identified pertains to the insufficient exploration of family dynamics and specific educational strategies tailored for diverse cultural contexts within diabetes management, particularly in relation to dietary adherence for T2DM patients. While existing literature emphasizes the importance of caregiver involvement and family education in enhancing dietary compliance and self-management behaviors [4], [7], there remains a lack of nuanced understanding regarding how family structures and cultural norms influence diabetes care across different populations [8], [9]. Furthermore, interventions such as the Calgary Family Intervention Model (CFIM) are yet to be comprehensively evaluated in varying sociocultural settings, which may limit the applicability of findings derived from predominantly homogenous groups [5], [10]. Additionally, while socioeconomic factors have been acknowledged as barriers to achieving dietary adherence, the specific mechanisms through which familial support and knowledge transfer occur require further investigation to optimize intervention strategies for diverse diabetic patient populations [5], [11].

To address this gap, we propose a study aimed at evaluating the effectiveness of the CFIM in improving dietary adherence and knowledge in patients with type 2 diabetes mellitus. Specifically, this study aimed to measure significant changes in dietary behavior and knowledge levels regarding diabetes management following the implementation of the CFIM during the intervention period. The novelty of this study fundamentally resides in the application of the CFIM, which underscores the importance of addressing the intersection of familial dynamics and chronic illness management, specifically in patients with type 2 diabetes mellitus. Unlike traditional family-based models, CFIM is premised on a comprehensive framework that integrates the family's roles, beliefs, and adaptive capacities, thereby offering a holistic perspective on disease management. This model uniquely facilitates understanding the psychosocial implications that extend beyond the individual patient, making it particularly relevant for conditions like type 2 diabetes that necessitate ongoing management and lifestyle adjustments. The quasi-experimental design enhances the methodological rigor by allowing for comparative assessments of conventional approaches versus CFIM-based interventions, thereby enriching the evidence base in this domain. These findings will contribute to illuminating pathways for nursing practices and health policies that advocate for integrative care models, emphasizing the necessity of family involvement in effective diabetes management strategies.

2. METHOD

2.1. Design

The research method used was quantitative with a quasi-experimental design using a two-group pre-test and post-test approach. The study was conducted at the Bolo Community Health Center, Bima Regency, from January to October 2025. The choice of a quasi-experimental design for this study is grounded in its practicality and ethical considerations in a community health setting. Unlike randomized controlled trials, quasi-experimental designs allow researchers to evaluate the effectiveness of interventions in real-world contexts where random assignment may not be feasible or ethical, especially involving patients with chronic conditions like type 2 diabetes mellitus. This approach enables comparison between an intervention group and a control group, allowing for observable differences in outcomes attributable to the educational intervention.

2.2. Setting

This research was conducted at the Bolo Community Health Center (*Puskesmas*) in Bima Regency, Indonesia, from January to October 2025. The Bolo Community Health Center was chosen as the research location because it is the primary healthcare facility providing services for patients with type 2 diabetes mellitus in the area. The research context at the Bolo Community Health Center is important because it provides a firsthand view of the challenges and needs of health education in the community.

2.3. Participants

The population participating in this study was patients with type 2 diabetes mellitus registered at the Bolo Community Health Center. A sample of 280 respondents was divided into two groups: 140 respondents in the intervention group who received education using CFIM, and 140 respondents in the control group who received educational media in the form of a booklet. Sampling was carried out using a purposive sampling technique, where selection was based on inclusion criteria, namely patients aged over 18 years, diagnosed with type 2 diabetes, and willing to participate in the study. Respondent allocation followed a purposive sampling technique, wherein participants were intentionally selected based on specific inclusion criteria: being over 18 years of age, diagnosed with type 2 diabetes for ≥5 years of disease duration, and consenting to participate. The total sample consisted of 280 patients, systematically divided into two groups of 140. The

intervention group received education through the CFIM, while the control group was provided with traditional educational materials. This clear delineation of group allocation facilitates robust comparisons between the efficacy of the CFIM approach and standard educational methods. A power analysis was performed to determine the sample size necessary to adequately detect statistically significant differences between the intervention and control groups concerning diabetes education outcomes. Utilizing a significance level (α) of 0.05, an anticipated effect size (Cohen's d) drawn from previous literature, and a desired power (1-β) of 0.80, the analysis indicated that approximately 140 participants per group were required, resulting in a total estimated sample size of 280.

The inclusion criteria for participant selection mandated that individuals be 18 years or older, diagnosed with type 2 diabetes mellitus, and willing to provide informed consent. Exclusion criteria encompassed patients diagnosed with type I diabetes or significant comorbid conditions that could interfere with dietary practices, pregnant or lactating women, and those adhering to dietary regimens unrelated to diabetes management, thus ensuring a homogeneous study population.

2.4. Intervention

The intervention procedure for education on type 2 diabetes mellitus aims to improve patient and family understanding regarding the management of this disease. The first step involves an in-depth explanation of type 2 diabetes mellitus, including potential complications and the important role of diet in its management. Next, the CFIM is implemented to involve family members in the education process, thereby creating a supportive environment that reinforces behavior change. Interactive discussions are a key part of this procedure, where patients and their families are encouraged to ask questions and share experiences, creating a positive atmosphere of engagement. The tutorial also includes the delivery of educational materials on a healthy diet, clearly explaining recommended and restricted foods. With this approach, it is hoped that patients will develop a better understanding of managing their diabetes through an appropriate diet and increase family support.

2.5. Instruments and measurements

Measurements in this study were conducted using a questionnaire that had been tested for validity and reliability to evaluate two main dimensions: patient knowledge about diabetes and a healthy diet, and patient adherence to the recommended diet. The first dimension involved evaluating patient knowledge before and after the intervention (pre-test and post-test). Data were collected to assess changes in patient understanding of diabetes management and the importance of a healthy diet. The second dimension focused on patient adherence to the recommended diet, also measured through pre-test and post-test. Through this approach, it is hoped that there will be an analysis of whether there is an increase in patient adherence after receiving education about a balanced diet and diabetes management. The use of a valid and reliable questionnaire plays a crucial role in generating accurate and accountable data, so that research findings can provide valuable insights for clinical practice and diabetes management in the community.

2.6. Variables

The independent variable analyzed was health education using the CFIM chronic care model approach. This education aims to improve patient understanding of type 2 diabetes mellitus management, which should focus on behavioral changes and patient mastery of health information. The dependent variables observed included dietary compliance of type 2 diabetes mellitus patients, which is a key indicator of the effectiveness of patient diet and health management, as well as patient knowledge about diabetes and appropriate diet, which reflects the extent to which the education provided can influence patient understanding and awareness of their health condition. The implications of this study are expected to provide evidence on the importance of an educational approach in improving dietary compliance and patient knowledge as part of effective diabetes management.

2.7. Analysis

Data analysis was conducted to evaluate the effectiveness of the intervention. First, the Wilcoxon test was used to analyze the difference between pre-test and post-test scores in the intervention and control groups. This test was chosen because of its ability to handle non-normally distributed data and provide information on changes within each group. Next, the Mann-Whitney test was applied to compare the mean differences between the intervention and control groups after treatment, allowing an assessment of how effective the intervention was compared to the group that did not receive the intervention. The significance level was set at $p < 0.05$, indicating that the observed differences were considered statistically significant, indicating that the results were unlikely to have occurred by chance. By using these two tests together, the analysis can provide a comprehensive picture of the intervention's impact.

3. RESULTS AND DISCUSSION

3.1. Results

Table 1 summarizes respondent characteristics, revealing that the intervention group had the highest proportion in the 36-40 age range at 27.86%, with a similar distribution in the control group. Gender distribution was nearly equal between groups, and education levels were balanced, though the control group had a slight majority with junior high or high school education (41.43%). Occupational status was comparable in both groups, and approximately 40% of respondents from each group had experienced type 2 diabetes mellitus for less than 5 years.

Table 1. Respondent characteristics

Variables	Intervention group		Control group	
	n	%	n	%
Age				
26-30	30	21.43	38	27.14
31-35	32	22.86	36	25.71
36-40	39	27.86	39	27.86
41-45	39	27.86	27	19.29
Sex				
Male	65	46.43	64	45.71
Female	75	53.57	76	54.29
Level of education				
Elementary school	30	21.43	30	21.43
Junior high school - senior high school	55	39.29	58	41.43
University	55	39.29	52	37.14
Employment				
Housewife	36	25.71	36	25.71
Private	35	25.00	34	24.29
Honorary	32	22.86	34	24.29
civil servant	37	26.43	36	25.71
Duration of illness				
<5 Years	56	40.00	57	40.71
6-10 Years	45	32.14	45	32.14
>10 Years	39	27.86	38	27.14

Table 2 indicates a significant increase in the average knowledge score of the intervention group, from 4.84±1.235 to 8.98±2.851, contrasting with the control group's increase from 4.64±1.120 to 7.06±1.219. The percentage of students with good knowledge rose from 21.43% to 50.71% in the intervention group. Similarly, compliance scores improved significantly in the intervention group, from 27.00±6.518 to 61.38±7.171, while the control group increased from 27.28±5.592 to 49.44±10.194, with good compliance rising from 21.43% to 54.29%.

Table 2. Knowledge and compliance before and after being given the CFIM approach

Variable	Intervention				Control			
	Pre-test		Post test		Pre-test		Post test	
	n	%	n	%	n	%	n	%
Knowledge Mean ± SD	4.84±1.235		8.98±2.851		4.64±1.120		7.06±1.219	
Good	30	21.43	71	50.71	30	21.43	50	35.71
Enough	49	35.00	39	27.86	50	35.71	59	42.14
Not enough	61	43.57	30	21.43	60	42.86	30	21.43
Compliance Mean ± SD	27.00±6.518		61.38±7.171		27.28±5.592		49.44±10.194	
Good	30	21.43	76	54.29	30	21.43	57	40.71
Enough	34	24.29	34	24.29	34	24.29	53	37.86
Not enough	76	54.29	30	21.43	76	54.29	30	21.43

In Table 3, the intervention group exhibited p-values of 0.000 and 0.003 for knowledge before and after the CFIM intervention, respectively, confirming a significant improvement in diabetes mellitus knowledge ($p < 0.05$). The control group also displayed a notable increase in knowledge with a p-value of 0.000, despite the absence of an intervention. Regarding dietary compliance, the intervention group showed p-values of 0.000 pre-intervention and 0.004 post-intervention, indicative of significant improvement. Conversely, the control group's compliance improved as well, reflected by a p-value of 0.002, albeit less robustly than the intervention group. The knowledge and compliance scores before and after the intervention are shown in Figure 1.

Table 3. Effectiveness of education through the CFIM approach on diet compliance in type 2 diabetes mellitus patients

Group	Intervention pre-test post-test	Control pre-test post-test	p-value
Knowledge	0.000	0.003	0.000
Compliance	0.000	0.004	0.002

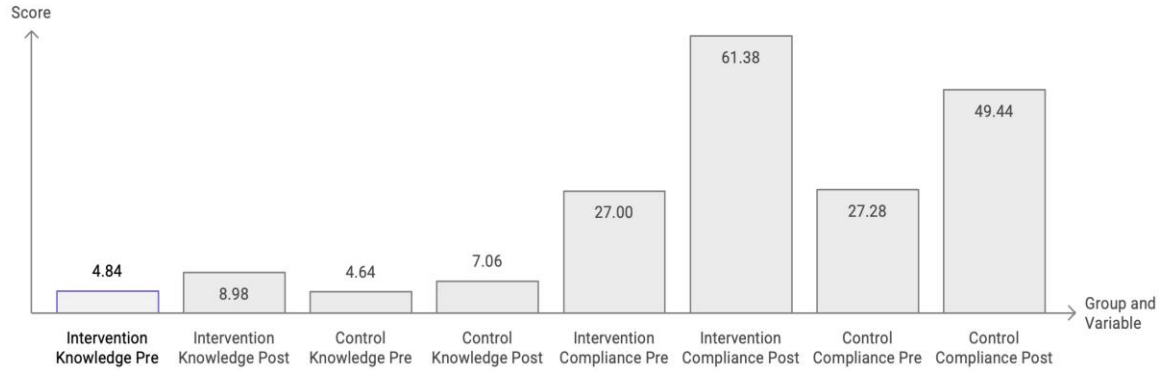

Figure 1. Knowledge and compliance scores before and after intervention

3.2. Discussion

The results presented indicate a substantial enhancement in both knowledge and compliance among participants in the intervention group, which employed the CFIM. Specifically, the mean knowledge score for the intervention group increased from 4.84±1.235 pre-intervention to 8.98±2.851 post-intervention, evidencing a notable improvement. This can be contrasted with the control group, which showed a more modest increase from 4.64±1.120 to 7.06±1.219. The percentage of students with good knowledge also significantly increased in the intervention group from 21.43% to 50.71%, highlighting the effectiveness of the CFIM in enhancing participants' understanding of relevant concepts and practices. This is consistent with findings from relevant literature that emphasize the positive impact of structured educational interventions on learner outcomes [12], [13]. In family members who experience diabetes mellitus with quality-of-life problems, there are positive changes to the family and in handling, nutrition, exercise, foot care, and stress management for the patient. It can be seen from the results questionnaire, which showed an improvement in scores than before, especially in the dimensions of physical and psychological health [13].

Literature supports the idea that structured family support positively correlates with adherence to dietary practices in diabetes management, reinforcing CFIM's emphasis on family involvement in health education [14], [15]. The overall improvement in both knowledge and compliance aligns with findings that highlight how targeted educational programs can enhance health outcomes by informing and empowering patients [16], [17]. Despite the control group's improvements, which may be attributed to additional external factors [18].

Regarding compliance, the intervention group demonstrated a significant rise in average scores from 27.00±6.518 to 61.38±7.171, while the control group's compliance improved from 27.28±5.592 to 49.44±10.194. Such discrepancies underscore the efficacy of the CFIM approach in fostering adherence to recommended practices. Increased compliance following educational interventions aligns with existing literature that suggests structured and interactive methods like CFIM can significantly augment both knowledge and behavioral change [19], [20]. Previous studies reinforce this finding, suggesting that structured educational interventions like CFIM significantly boost both knowledge and behavioral changes among patients [21]. Moreover, culturally tailored applications of educational interventions have shown positive outcomes in improving treatment adherence, demonstrating that enhanced compliance correlates with better health outcomes [22], [23].

Moreover, the increase in the percentage of students classified with good compliance in the intervention group from 21.43% to 54.29% reinforces the premise that educational interventions can significantly enhance not just knowledge but the practical application of that knowledge in real-world healthcare settings. Further evidence supports the notion that targeted educational programs result in improved adherence to safety and practice protocols [24], [25]. The marked improvements in both knowledge and compliance within the intervention group following the CFIM approach suggest that structured, evidence-

based educational strategies can have a profound impact on health education. Such findings advocate for the continued integration of innovative educational frameworks within nursing and health professional curricula, which may lead to improved competence and practice fidelity among healthcare providers [26]-[28].

In the intervention group, the pre- and post-intervention p-values concerning knowledge (0.000 pre-test and 0.003 post-test) suggest that the CFIM significantly enhanced patient awareness and understanding of diabetes mellitus. These results are corroborated by findings from Njock *et al.* [29], who emphasize the critical importance of diabetes education in disease management, treatment compliance, and improving health outcomes for patients with type 2 diabetes mellitus. Furthermore, Setyoadi *et al.* [4] highlight how educational interventions significantly bolster dietary adherence, reinforcing the direct link between improved understanding of diabetes and compliance with dietary recommendations.

It is notable that the control group also exhibited an improvement in knowledge (p-value of 0.000). This raises questions about whether other external factors, such as general environmental influences or passive information absorption, played a role in this improvement. Encouragingly, research indicates that mere exposure to health-related information can lead to increased knowledge, albeit to a lesser extent than targeted educational programs, reflecting the complex interplay of structured education versus spontaneous learning in patient populations [30].

In terms of dietary compliance, both the intervention group and the control group showed significant results. The intervention group had a p-value of 0.000 before and 0.004 after the intervention, reflecting a substantial increase in compliant eating behaviors. This reinforces findings from Han *et al.* [31], which indicate that individualized education sessions play a vital role in synthesizing knowledge and motivating adherence to recommended dietary guidelines. The control group's p-value of 0.002, while indicating some improvement, remains weaker than that of the intervention group, illustrating the distinct advantage provided by the CFIM, which incorporates tailored, supportive interventions that foster a deeper connection between knowledge and behavioral change. Evidence indicates that tailored interventions, such as those described by Ji and Liu [32], can effectively enhance dietary compliance through empowerment strategies that foster self-management.

The findings are particularly significant given the ongoing issues related to patient non-compliance in diabetes management. Studies have shown that educational interventions can promote better self-management, leading to improved health outcomes [33]. Additionally, adherence to dietary guidelines is influenced by factors such as prior knowledge and support systems, both of which are effectively addressed through structured education [34]. Sami *et al.* [30] have discovered that diabetic patients with a strong understanding of dietary needs exhibited notably better adherence to nutritional guidelines and management practices.

The ongoing challenges related to patient non-compliance in diabetes management highlight the necessity for effective educational interventions. Evidence suggests that such interventions can enhance self-management skills among diabetic patients, ultimately resulting in improved health outcomes [7], [35]. Furthermore, dietary adherence is closely associated with an individual's prior knowledge and available support systems, aspects that structured educational programs can effectively address [6], [36]. Specifically, research indicates that diabetic patients who possess a strong understanding of their dietary needs exhibit better adherence to recommended nutritional guidelines [36]. These findings emphasize the critical role of tailored education in promoting dietary compliance and managing diabetes effectively.

Moreover, it must be acknowledged that educational interventions yield better knowledge and compliance outcomes while enhancing the overall quality of life for patients with diabetes. Programs like the CFIM are crucial, as they foster proactive engagement and ongoing self-management, vital for successful diabetes care [37]. The dynamic environment created during these interventions helps build a supportive community among patients, which Chepulis *et al.* [38] indicate can further enhance outcomes for at-risk populations.

4. CONCLUSION

The implementation of the CFIM significantly improved dietary knowledge and adherence in patients with type 2 diabetes mellitus in the intervention group. The results from Table 2 show that the average knowledge score in the intervention group increased from 4.84±1.235 to 8.98±2.851, while the control group experienced a smaller increase. The good knowledge category also increased significantly from 21.43% to 50.71% in the intervention group. For the adherence aspect, the average score in the intervention group increased significantly from 27.00±6.518 to 61.38±7.171, with the good adherence category increasing from 21.43% to 54.29%. Statistics show that the p-values for knowledge and adherence in the intervention group were 0.000 and 0.004, respectively, indicating strong significance. Meanwhile, the control group also showed an increase, but not comparable to the intervention. These findings underscore the importance of using the

CFIM approach in improving health education outcomes for diabetes patients. The findings from this study advocate for healthcare policymakers to integrate CFIM into diabetes management programs, emphasizing patient-centered interventions that can augment dietary knowledge and adherence, ultimately leading to better health outcomes for type 2 diabetes mellitus patients. The necessity for resource allocation towards enhancing family involvement in diabetes education is underscored, suggesting a pathway to sustainable health improvements. Future research avenues include investigating the long-term impacts of the CFIM on dietary practices beyond immediate post-intervention results, as well as its effectiveness across various demographics and cultural contexts. Longitudinal studies are recommended to further elucidate the enduring effects of family-centered interventions. Notably, this study contributes to the existing literature by establishing the CFIM's unique capacity to significantly improve dietary knowledge and adherence, thereby presenting novel evidence that enhances our understanding of diabetes management and education. The limitation of the study's short duration of follow-up (pre-test and post-test immediately after intervention) restricts the assessment of the long-term sustainability of knowledge retention and compliance. Potential confounders such as external educational influences or varying levels of family support were not controlled for, which may have influenced the outcomes.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Muhtar	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Aniharyati	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
Julhana	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
Fadlurahmi	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓
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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

ETHICAL APPROVAL

This research has received ethical approval from the Mataram Ministry of Health Polytechnic with the number: 060/EA/KEPK/2025.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [AH], upon reasonable request.

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